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(19) (CA) **CANADIAN PATENT** (12)

(54) LUBRICANT FOR DEEP DRAWN CANS

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ABSTRACT OF THE DISCLOSURE

A lubricant is provided to help in drawing containers such as cans from tinplate or coated tin free steel and to assist the metal forming process during drawing. The lubricant is formulated to permit a post spray without removal of the lubricant thereby eliminating washing and drying the container before post spraying. Post spray coatings are solvent or water based and are necessary to protect the container from the harmful effects of the material carried within the container and in turn to prevent contamination of the product by its container. A method of lubricating a metal to be deeply drawn into a sanitary can is explained and includes leaving the lubricant on the can during interior post coating operations.

Background of the Invention

The process in forming deeply drawn containers requires a lubricated sheet stock for proper forming. Such lubricants include peanut oil, lanolin, petrolatum and castor oil, and many others. It is possible to deeply draw a container lubricated with any of the mentioned lubricants and others, see for example United States Patent No. 4,042,515. Deep drawing permits forming a two-piece drawn can which is a preferred container in that the only seam is at the cover. The practice of heavily lubricating the sheet stock for a two-piece deeply drawn can is necessary because of the stresses introduced during forming. While certain chlorinated paraffins when used as draw lubricants may be post coated without removal they are not approved for such use in a food container by the Food and Drug Administration without complete removal prior to post coating. The lubricant of the present invention is approved when applied as set forth and post baked. No other acceptable technique is available to manufacture drawn and redrawn cans which will permit direct post coating operations on the completed cans (on either the inside or the outside surface). The most frequent method of coating application is by post spraying the cans using a typical can makers spray machine, where the cans are brought into position in front of a stationary spray nozzle, are sprayed, and are then carried away to a curing over. Prior to that operation, all cans to be sprayed must be washed thoroughly to remove all traces of lubricant used to allow forming of the original plate into the container shape. This applies to cans made by draw/redraw methods or by drawing and ironing techniques (see for example RE 27,662). The problem in both cases with the cleaning operation is that the lubricant has been forced into all available pores, aberrations, interstices, etc. in the metal surface due to the high pressure applied by the tooling to the metal

in order to form it, in th presence of lubricant. The washing must be done with the aid of chemical cleaners, the cans must be rinsed with deionized water to remove all traces of the cleaner, and the cans must then be oven dried in order to eliminate spotting from residual rinse water. The cost of this operation depends to some extent on the size of the can, the number of cans produced per year, and other factors (such as neutralization needed in order to send the cleaning solution into a sanitary sewer system, quality of the water available for the original wash cycle, etc.). Drawn containers of precoated metals are commercial but it is recognized that a post sprayed container can have superior product resistance for certain hard to hold foods.

The three-piece container which had a body rolled into a cylinder and side seamed and two double seamed ends and as such are precoated and don't require any lubricant. Thus, it was easier to process. Consequently, the need to remove the heavy lubrication on two-piece cans after deep drawing requires can washing and drying energy, equipment and materials. Each is costly in terms of capital investment, plant space and energy consumption. In addition, the drying process was environmentally deleterious in that vapors are driven off and in that fuel is consumed generating heat and leaves products of combustion.

The present invention essentially eliminates the need to wash lubricants for deep drawing.

The present invention also provides a lubricant with these properties which will also effectively permit the strip to be deeply drawn without surface damage to the metal from which the container is formed.

The present invention still further provides a lubricant which can be successfully overcoated during a post spraying operation and which will permit the post coating to form a strong bond with the container.

According to the present invention there is provided a deep drawing and priming composition for precoating metallic stock having a metal oxide surface prior to deeply drawing into food containers consisting essentially of a combination of lubricant compatible with aliphatic hydrocarbon type solvents being three and two-tenths percent by volume of the composition, an air drying type hydroxylated silicone resin sufficiently equipped with silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface of said silicone resin being eight-tenths percent by volume of the composition and the remaining ninety-six percent of the composition being solvents and said precoated food container thereafter being receptive due to being so primed to a further protective postcoating.

The present invention also provides a method of preparing thin metallic stock having an oxidized surface for deep drawing into food containers and postcoating said container including the steps of: a) applying a combination of lubricant compatible with aliphatic hydrocarbon-type solvents and air drying type hydroxylated silicone resin sufficiently equipped with reactive hydroxyl groups to bond with said metal oxides and to consense with acid groups in said lubricant for forming a uniform dispersion of said composition across the stock surface said silicone resin in a four-to-one mixture by volume dissolved in approximately 25 volumes of solvent at a rate of about 20 mgs per square foot to the surfaces of a thin sheet of said oxidized metal stock to be formed, b) providing sufficient hydroxyl groups to bond with the metal oxides and to condense with acid groups in said lubricant, c) permitting said combination and solvent to dry leaving an evenly deposited film over the surfaces of the thin sheet, d) progressively forming by deep drawing the film covered sheet into a deeply drawn food container having a depth which is greater than its width, and

e) spraying a post-coating to substantially seal over the film covering the food container to the extent that negligible surface areas remain uncovered by the postcoating.

It has been thus found that the problems of the prior techniques can be successfully overcome by a lubricant that permits direct overspray of the drawn can interior after forming but without removal of the remaining lubricant thereby saving expense and energy normally associated with the handling, the cleaning, the washing and/or the drying processes. The lubricant is a combination of General Electric's silicone resin supplied under the trade mark SR82 mixed in a toluene solution to a concentration of 60% solids, and lanolin carried in a solvent such as Skelly C (a trade mark) being heptane. The concentration of the combination contains 4% by volume of the lubricant materials or, expressed in another way approximately 3.68% of solids. A combination where one part by volume SR82 and toluene (60% solids) are mixed with four parts by volume of 100% liquid lanolin, and the combination then dissolved in toluene and heptane is preferred. The aromatic solvent toluene is used to prevent precipitation of the SR82 (a trade mark) silicone resin and the aliphatic heptane fraction gives good solvency to the lanolin. Tests of different concentrations of lubricant solids applied to bare tinplate stock by roller application and felt-wipe have produced good results in that post spraying without can washing produced an acceptable internal coverage with good adherence. Different coating systems sprayed over the preferred lubricant have been tried including solvent based coatings such as an epoxy-phenolic type or a vinyl-organosol. The solvents consisting of oxygenated, aromatic, and aliphatic hydrocarbon types. Water based materials which are preferred for environmental reasons have also been tried with good results.

More particularly, the post sprayed container can be quickly tested by filling it with an electrolyte and checking the

continuity or lack thereof between the outside of the container body and an electrode in the center of the electrolyte. Such a procedure is called quick testing and is common in the can manufacturing industry.

In order to perform a quick test a specified piece of equipment is required. More particularly, a Model 1071 WACO (a trade mark) Enamel Rater with a 0 to 1 milliamp attachment is used. The apparatus has an electrode which is adapted to move vertically in and out along the axis of a can positioned beneath it. The electrode is positioned about 1" from the bottom of the can. The can is held in position by a vise-like device which clamps it about the bottom holding it so that the open end of the can forces up toward the electrode. The can is filled with 2% solution of sodium sulfate and allowed to soak for at least 30 seconds before the electrode is dropped into the can. The solution temperature should be maintained between 72 to 78°F, and the can should be filled so that when the electrode is lowered into the test position the solution will reach approximately 1/8" below the top flange radius. Care should be taken to avoid wetting the flange since that will result in a false high reading. The milliamp meter of the tester is connected to the vise-like device which holds the bottom of the can. The electrode is connected to another lead of the milliamp meter. A zeroing of the instrument is required and the operator adjusts the milliamp to read "T" on the scale. Shortly after zeroing the meter a warning light comes on and the reading should be taken immediately. When this procedure was applied to the cans postcoated over the combined lubricant and silicone resin, readings in the range of 0 to 3 milliamps were obtained and such data is indicative of properly coated cans. The cans were subsequently packed with various food and processed at temperatures of 240-270°F. Taste tests and analytical studies have verified the efficacy of the coatings as applied over the combination.

Although post sprayed coatings generally yield quick test readings in the range of 1 to 3 milliamps, there can be an occasional small ar a of metal exposure resulting from a piece of dirt on the surface as it is being sprayed, or dirt from particles in the air during oven curing, and those areas are sometimes attacked by the product packed in the can. By choice of the proper metal substrate (electrolytic tin plate of various tin weights, or tin free steel - CT) various foods can be packed and properly held. Possible metal exposure is the reason for different metal substrates being used for different products, even though the post spray coating is the same. In the event of exposure, tin coatings on the substrate will reduce the amount of attack by the more active foods. For example, coated TFS-CT is adequate for beef stew, but probably not for green beans, which may require coated #25 or #50 ETP, and certainly not for blueberries or red sour pitted cherries, which normally require coated #75 or #100 ETP pounds per base box which is the industry convention for amount of electrolytically deposited tin on steel. Similarly, peanut oil has also been mixed with General Electric's SR82, and has upon checking with quick test, after post spraying, performed successfully.

Explanation of the Invention

Certain silicone resins such as General Electric's SR82 are known for their ability to modify coatings and thereby enhance their bond with a metal substrate to which they are applied. More particularly, the addition of silicone resin such as General Electric's SR82 (a trade mark) to lanolin acts to permit subsequently applied coatings (after forming) to cover the surface of the metal substrate completely. That is to say that, without the addition of silicone resin to the lanolin it would prevent complete coverage of portions of metal substrates by coatings applied after forming leaving eye holes, discontinuities in the coverage or even tendencies for the coating to bead up. The affect is much like water on

freshly waxed surfaces. The addition of silicone resin permits a wetting action and alters the surface tension of the lanolin surface tension of the lanolin sufficiently to allow the coatings as applied to spread evenly and completely over the lubricated (lanolin and silicone resin combination) metal substrate and to form a good bond across the entire surface. The proposed combination of silicone resin and lanolin when preapplied to coils or panels of tin free steel plate, electrolytic tinplate or other materials for deep drawing containers or cup-like objects which are intended to be post sprayed or post decorated performs successfully because of the bonding and good adherence of the wettable combination to the lubricated metal surface. If lubrication is the only requirement, a complete coverage of the metal surface is not necessary since the drawing tools tend to spread whatever lubricant is available and a coating of lubricant builds on the tools to the extent that sufficient lubrication is available for the forming process even on material which is slightly under lubricated. The wetting is necessary to provide sufficient adherence to the metallic substrate.

The lubricant and silicone resin combination is applied as a solvent solution such that the combination remains as a film on the surface of the metal after the solvent has evaporated. Consequently, the lubricant may be applied to the plate to be drawn several days prior to use (so long as the surface so coated is protected from settling dust impurities). The evaporation time for the solvents at normal room temperature when applied in the concentrations preferred is approximately 20 seconds, if a roller type applicator is used in combination with a felt wiper to remove the excess.

Example 1

A 4% mixture may be made by dissolving 24 milliliters of SR82 (a trade mark) as received from General Electric (a toluene

solution of a specific pure silicone resin with 60% solids) in sufficient toluene to make 1550 ml total solution. To this was added a solution of 90 ml of liquid lanolin (Ritalan (a trade mark) 100% pure, from R.I.T.A. Chemical Company) in sufficient Skelly (a trade mark) "C" (Heptane) to make 1450 ml of total solution. The combination gives approximately 3000 ml containing 4% by volume or 120 ml of the lubricant materials such that the solids concentration would be about 3.68%. The combination was applied to coil stock feed to the press and in the actual operation sufficient time to permit evaporation of the solvents was available when the distance between the felt wiper and the centerline of the press tools was 17 feet. The stock 50/100 ETP as received from the steel mill was fed at a rate of 8 1/2" per second and the combined lubricant and resin were applied at a rate of 15 to 25 mgs per square foot. The best lubricant in solvent concentration was found to be approximately 4% by volume or more particularly 4.5% $\pm$ .5%. This concentration was necessary for lubricating in a continuous draw/redraw process, with a total of three drawing stations. If it is merely a drawing operation with only one step forming the lubricant concentration can be lowered to 2% by volume, and applied at 8 to 12 mgs per square foot. Ten thousand cans were deeply drawn in three stations and post coated with an epoxy phenolic solvent based coating. The coating was applied by spray at a rate sufficient to give a weight of about 25 mg per 4 square inches and then baked at 400°F for seven minutes in a continuous oven. Quick test results on randomly sampled containers gave readings of 0-3 ma.

Example 2

The combination of silicone resin and lanolin was the same as in Example 1, however, the metal stock was strip fed, TFS-CT precoated on both sides with an expoxy-vinyl coating at a level of 13 mg per 4 square inches. Felt wipers were saturated with the

combination and the surfaces wip d across the wet wipers to coat the strips. Five thousand containers were drawn and redrawn in a three step operation and subsequently post coated as set forth in Example 1. Quick test results were extremely good in that readings were between 0-1 ma.

Example 3

One part of petrolatum by volume was mixed with 1.66 parts by volume of SR82 (a trade mark) as received from General Electric. The mixture was thinned with about 50 parts of toluene to give a 4% by weight solution. The combination was applied by the procedure of Example 2 to the metal materials of Examples 1 and 2 and containers were drawn and redrawn in three operations as before. The post coating in this Example was an epoxy water base material applied by spraying at a rate of about 20 mg per 4 square inches and cured in continuous operation at 380°F for 2 minutes. Quick test results have readings of 5 to 25 ma.

Example 4

The combination of silicone resin and lanolin of Examples 1 and 2 applied as in Example 2 on the material of Example 2 and post coated with the water base epoxy of Example 3. Quick test results gave readings of 1 - 4 ma for material Example 1 and 0 ma for the other.

Example 5

This was identical to Example 1 except that peanut oil was used in place of lanolin as the lubricant in the combination. The quick test results gave readings of 5 to 9 ma which was not as good but for some foods would be acceptable.

A typical container as formed by the draw/redraw process using the lubricant combination of this invention is a 303 x 406 two-piece steel can. The inside diameter of the triple drawn finished container is 3.060", the height is 4.375", and the bottom and sidewall thickness are approximately 0.0083", when the feed

stock was 75 #T-4 plate; either TFS-CT tin free steel or electrolytic tinplate having various tin weights deposited on both sides of the plate will perform acceptably.

The combination of lanolin and General Electric's SR82 can be applied as described previously from a solvent solution using a roller applicator and suitable doctor blades or felt wipers to remove the excess so as to yield about 20 mgs per square foot of the combination on each side of the plate to be treated, after the solvents are removed. The combination can also be applied from a solvent dissolved system where the combination is at concentrations as high as about 60% (in toluene as the solvent) by spraying onto the plate to be lubricated. A typical installation for applying lubricants to strips of plate in this manner employs a continuous conveyor belt which brings the strips past an air atomizing nozzle which is spraying the combination downward onto the plate. Through adjustments to the nozzle flow rate, and by varying the speed of the belt, a coverage of about 20 mgs per square foot is readily attained. Similarly, such a spray or atomizing system could be used to lubricate a precoated TFS-CT coil on a coil coating line, or to lubricate a coil of uncoated electrolytic tinplate which is to be converted to containers suitable for post coating without further washing or cleaning treatment.

While the preceeding has dealt with various examples and various materials, the invention in its braodest aspect is considered to include any type of silicone resin with the appropriate drawing lubricant which permits a subsequently applied coating to spread evenly over the remaining combination after a deep drawing operation and results in a good bond to the metal sbustrate after curing of the coating. For specific applications which require more severe draws and/or thinner post coatings, the amounts of the various constituents in the combination can be varied in order to maintain low costs with a lubricant which will perform

successfully. In addition, post coating of all ranges of tin coverage on steel will work successfully with this type of lubricant combination. Lightly precoated tin free steels (TFS-CT) will also succeed in processing into post coatable containers using this combination.

PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A deep drawing and priming composition for precoating metallic stock having a metal oxide surface prior to deeply drawing into food containers consisting essentially of a combination of a lubricant compatible with aliphatic hydrocarbon type solvents being three and two-tenths percent by volume of the composition, an air drying type hydroxylated silicone resin sufficiently equipped with silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface said silicone resin being eight-tenths percent by volume of the composition and the remaining ninety-six percent of the composition being solvents and said precoated food container thereafter being receptive due to being so primed to a further protective postcoating.

2. The composition of claim 1 wherein the lubricant is one hundred percent lanolin.

3. The composition of claim 1 wherein the lubricant is peanut oil.

4. The composition of claim 2 or 3 wherein said solvents are approximately equal portions of aromatic and aliphatic hydrocarbons.

5. A deep drawing composition for precoating metallic stock having a metal oxide surface prior to drawing and redrawing into food containers consisting essentially of a combination of a lubricant compatible with an aliphatic hydrocarbon-type solvent and being one and six-tenths percent by volume of the compound and air drying type hydroxylated silicone resin containing 2 - 4% by weight silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface said silicone resin being four-tenths of one percent by volume of the compound and the

remaining ninety-eight percent of the compound being solvents and said precoated food container thereafter being receptive due to being so primed to a further protective postcoating.

6. A deep drawing and priming composition for precoating plate prior to drawing food containers consisting essentially of a combination of a lubricant compatible with an aliphatic hydrocarbon-type solvent and air drying type hydroxylated silicone resin sufficiently equipped with silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface wherein said combination includes four times as much lubricant as silicone resin and sufficient solvent to carry in solution said combination at an appropriate viscosity for application and said precoated food containers thereafter being receptive to a further postcoating.

7. The composition of claim 5 wherein the solvent percentage is in the range of forty to ninety-eight percent of the total composition.

8. A method of preparing thin metallic stock having an oxidized surface for deep drawing into food containers and postcoating said container including the steps of: a) applying a combination of lubricant compatible with aliphatic hydrocarbon-type solvents and air drying type hydroxylated silicone resin sufficiently equipped with reactive hydroxyl groups to bond with said metal oxides and to condense with acid groups in said lubricant for forming a uniform dispersion of said composition across the stock surface said silicone resin in a four-to-one mixture by volume dissolved in approximately 25 volumes of solvent at a rate of about 20 mgs per square foot to the surfaces of a thin sheet of said said oxidized metal stock to be formed, b) providing sufficient hydroxyl groups to bond with the metal oxides and to condense with acid groups in said lubricant, c) permitting said com-

bination and solvent to dry leaving an evenly deposited film over the surfaces of the aluminum sheet, d) progressively forming by deep drawing the film covered sheet into a deeply drawn food container having a depth which is greater than its width, and e) spraying a postcoating to substantially seal over the film covering the food container to the extent that negligible surface areas remain uncovered by the postcoating.

9. The method of claim 8 wherein the composition is applied by rolling and wiping.

10. The method of claim 8 where the application is by air atomized spraying.

11. The method of claim 8 wherein the application is by airless spraying.

12. The method of claim 8 wherein the solvent is approximately equal portions of aromatic and aliphatic hydrocarbons.

13. The method of claim 12 wherein said sprayed post coating is an epoxy water based material applied at a rate to give about 20 mg per .4 square inches which is cured for two minutes in a continuous operation at 380°F.

14. The method of claim 12 wherein an epoxy phenolic solvent based coating is sprayed at a rate to give about 25 mgs per 4 square inches which is cured for 7 minutes in a continuous operation at 400°F.

15. The method of claim 12 wherein an epoxy vinyl precoating at 13 mg per 4 square inches is on the metal before the combination is applied and the post coating is with an epoxy phenolic solvent based coating at a rate to give about 25 mgs per 4 square inches which is cured for 7 minutes on a continuous operation at 400°F.

16. The method of claim 12 wherein the aromatic hydrocarbon is toluene and the aliphatic hydrocarbon is heptane.

PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A deep drawing and priming composition for precoating metallic stock having a metal oxide surface prior to deeply drawing into food containers consisting essentially of a combination of a lubricant compatible with aliphatic hydrocarbon type solvents being three and two-tenths percent by volume of the composition, an air drying type hydroxylated silicone resin sufficiently equipped with silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface said silicone resin being eight-tenths percent by volume of the composition and the remaining ninety-six percent of the composition being solvents and said precoated food container thereafter being receptive due to being so primed to a further protective postcoating.

2. The composition of claim 1 wherein the lubricant is one hundred percent lanolin.

3. The composition of claim 1 wherein the lubricant is peanut oil.

4. The composition of claim 2 or 3 wherein said solvents are approximately equal portions of aromatic and aliphatic hydrocarbons.

5. A deep drawing composition for precoating metallic stock having a metal oxide surface prior to drawing and redrawing into food containers consisting essentially of a combination of a lubricant compatible with an aliphatic hydrocarbon-type solvent and being one and six-tenths percent by volume of the compound and air drying type hydroxylated silicone resin containing 2 - 4% by weight silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface said silicone resin being four-tenths of one percent by volume of the compound and the

remaining ninety-eight percent of the compound being solvents and said precoated food container thereafter being receptive due to being so primed to a further protective postcoating.

6. A deep drawing and priming composition for precoating plate prior to drawing food containers consisting essentially of a combination of a lubricant compatible with an aliphatic hydrocarbon-type solvent and air drying type hydroxylated silicone resin sufficiently equipped with silanol groups to bond with said metal oxides and to condense with acid groups in said lubricant for uniform dispersion of said composition across the stock surface wherein said combination includes four times as much lubricant as silicone resin and sufficient solvent to carry in solution said combination at an appropriate viscosity for application and said precoated food containers thereafter being receptive to a further postcoating.

7. The composition of claim 5 wherein the solvent percentage is in the range of forty to ninety-eight percent of the total composition.

8. A method of preparing thin metallic stock having an oxidized surface for deep drawing into food containers and postcoating said container including the steps of: a) applying a combination of lubricant compatible with aliphatic hydrocarbon-type solvents and air drying type hydroxylated silicone resin sufficiently equipped with reactive hydroxyl groups to bond with said metal oxides and to condense with acid groups in said lubricant for forming a uniform dispersion of said composition across the stock surface said silicone resin in a four-to-one mixture by volume dissolved in approximately 25 volumes of solvent at a rate of about 20 mgs per square foot to the surfaces of a thin sheet of said said oxidized metal stock to be formed, b) providing sufficient hydroxyl groups to bond with the metal oxides and to condense with acid groups in said lubricant, c) permitting said com-

bination and solvent to dry leaving an evenly deposited film over the surface of the thin sheet, d) progressively forming by deep drawing th film covered sheet into a deeply drawn food container having a depth which is greater than its width, and e) spraying a postcoating to substantially seal over the film covering the food container to the extent that negligible surface areas remain uncovered by the postcoating.

9. The method of claim 8 wherein the composition is applied by rolling and wiping.

10. The method of claim 8 where the application is by air atomized spraying.

11. The method of claim 8 wherein the application is by airless spraying.

12. The method of claim 8 wherein the solvent is approximately equal portions of aromatic and aliphatic hydrocarbons.

13. The method of claim 12 wherein said sprayed post coating is an epoxy water based material applied at a rate to give about 20 mg per 4 square inches which is cured for two minutes in a continuous operation at 380°F.

14. The method of claim 12 wherein an epoxy phenolic solvent based coating is sprayed at a rate to give about 25 mgs per 4 square inches which is cured for 7 minutes in a continuous operation at 400°F.

15. The method of claim 12 wherein an epoxy vinyl precoating at 13 mg per 4 square inches is on the metal before the combination is applied and the post coating is with an epoxy phenolic solvent based coating at a rate to give about 25 mgs per 4 square inches which is cured for 7 minutes on a continuous operation at 400°F.

16. The method of claim 12 wherein the aromatic hydrocarbon is toluene and the aliphatic hydrocarbon is heptane.